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High Pressure Research
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

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INTRODUCTION

T .s is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R&D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.

For further information the reader is invited to call Stuart Hibben or Lee Boylan at Informatics on (301)-770-3000.

Acoustic Noise in Turbulence (abstract)

The leading Soviet acoustics journal has given an extensive review of achievements in acoustic research under the latest 5 year plan (1971-1975). In the area of hydroacoustics, particular mention is made of recent interest in sound emission from turbulent fluid flow, including jets and boundary layers. Intensive research is mentioned on acoustic aspects of cavitation and cavitational flow; on effects of acoustic vibrations on flow stability, on the nature of vortex noise; and on the effect of boundary layer control on noise characteristics. Tests have shown, for example, that injection of polymers into the boundary layer not only reduces drag but also significantly lowers the level of pressure fluctuations within the boundary layer. Boundary layer control by fluid draw-off or blow-off has also been found to lower pressure variations in the low frequency range. Numerous characteristics of sound generated by a turbulent boundary layer have been investigated theoretically; studies of vortex noise is cited as an example, where it has been shown that a vortex passing over a nonuniform surface can accelerate and emit sound. Other studies have been done on the effect of acoustic vibrations on flow stability in a boundary layer. [_____. Developments in Soviet acoustics during the 9th Five Year Plan. Akusticheskiy zhurnal, no. 2, 1976, 165].

Acoustic Sounding of the Atmosphere (abstract)

In a collection of articles otherwise devoted to laser propagation in the atmosphere, one paper on problems of acoustic sounding is included. The authors examine theoretical methods for optimizing antenna arrays to minimize cross-coupling, which is a principal limiting factor in the acoustic sensing threshold. No reference to experimental data is made, but earlier work of Middleton and other authors in this field is cited. Advantages of acoustic sounding for determining troposphere wind profiles, turbulence and "temperature turbulence" are pointed out, and increased attention to this technique is suggested. However, reportage of Soviet work in acoustic sounding of the atmosphere has been very sparse to date. [Glazov, G. N. and Gr. N. Glazov. Effect of interantenna coupling on detection threshold in acoustic sounding of the atmosphere. IN: Rasprostraneniye opticheskikh voln v atmosfere (Propagation of optical waves in the atmosphere), SOAN SSSR, Novosibirsk, 1975, 229-233].

Self-Focusing of Ultra and Hypersound (abstract)

A unified theory of stationary self-focusing is developed in the case of high-intensity ultrasonic and hypersonic waves propagating in a non-linear medium. General equations of thermal stationary self-focusing are developed by the authors, using the approximation of a slowly varying wave amplitude and increasing temperature in direction of the beam. Analytical solutions are obtained for both weakly-absorbing and strongly-absorbing media, assuming that diffraction is negligible.

A differential equation of beam width, taking into account beam divergence caused by diffraction, is also derived, using the paraxial beam approximation. Expressions are derived for critical power of beam self-channeling (wave-guide propagation) in weakly- and strongly-absorbing nonlinear media. The derived formulas are used to calculate numerical values necessary for the experimental realization of self-focusing. [Sardaryan, V. S. and A. V. Shekoyan. Stationary self-focusing of ultra- and hypersound in a non-linear medium. Akusticheskiy zhurnal, no. 1, 1976, 101-106].

Academician Brekhovskikh on Ocean Research for the New 5-Year Plan (abstract)

In light of the recently announced Five-Year plan, Academician L. Brekhovskikh discusses both general and specific areas of Soviet ocean research plans for resource exploitation and classical oceanography. Following a rather long generalization on the exploitation of living and non-living ocean resources, Brekhovskikh states that the Oceanographic Commission of the USSR Academy of Sciences has generated its own 5-year plan which, in 1976 alone, calls for more than 100 research cruises to the major oceans and seas, and a like number of projects to be performed in coastal waters. Greater emphasis will be placed on inter-institutional cooperation in cruises, as well as Soviet-bloc and international cooperative cruises and programs.

Planned national programs include Project DINEKT (study of the dynamics of the equatorial currents and local water structure); Project Volna [wave] (theoretical and experimental research on surface and internal waves in the World Ocean); Project Biotalassa [Biothalassa] (study of oceanological basis of the biological productivity of prospective fishing areas in the deep ocean); Bioshel'f (study of the oceanological basis for the emergence of prospective fishing areas in continental shelf and slope areas); and Project Geos (study of sediment-layer structure in the ocean). The need for more research ships, better instrumentation, and expanded shore facilities is mentioned [Brekhovskikh, L. The ocean beckons. Izvestiya, 16 March 1976, p. 5, cols. 1-3].

Increased Emphasis on Dolphin Research (abstract)

A recent issue of the journal Bionika, published by the Ukrainian Academy's Institute of Hydromechanics, reviews recent findings in hydrobionic research, specifically in more detailed studies on swimming physiology and boundary surface effects of dolphins, whales and other marine life. The issue is devoted almost entirely to these phenomena, as seen from the list of article titles:

- o Results of hydrobionic research (review)
- o Linear theory of deformation of elastoosmotic polymer structures (artificial muscles)
- o On bird flight near a shielding structure
- o Hydrodynamic analysis of fin profiles of dolphins and whales

- Using stereo photography to study the fin kinematics of dolphins
- Characteristics of the trunk and tail fin forms of whales
- Swim kinematics of the dolphins
- Flow regime in the boundary layer of a dolphin model
- Calculating pressure at the surface of a deforming ellipsoid of revolution
- Fluid flow over elastic bodies
- Absorption of pulsed energy in a damping layer
- Two-layer model of wall turbulence in weak polymer solutions
- Effect of pH level on reducing hydrodynamic resistance of weak polymer solutions.
- Laminar flow of polymer solutions in a helical tube
- A possible operative mechanism for the slime coating of fish
- Characteristics of slime influx into a fish body surface
- Comparative hydrodynamic effectiveness of polyoxyethylene solutions and skin separations of marine creatures
- Contribution of amino acid to effectiveness of reducing hydrodynamic drag in the surface slime of Black Sea fish
- Change in structure of a shark's skin as a function of conversion to a rapid swim mode
- Analogs in conversion to rapid swim modes of sharks and bony fish
- Optimal kinematics of finned propulsion systems, and resonant modes of fish swimming
- Transfer function of the tail fin of a marine organism
- Quantitative evaluation of acoustic signalling in three types of Black Sea dolphins
- Study of the food-discovery signal of the dolphins
- Structure of dolphin vocal signals
- Implanting sensors for mean and pulsed pressures in the skin of marine creatures
- Characteristics of accommodation of alloplastic materials to the skins of various marine mammals
- Functional anatomy and sound-generating features of the upper air canals of Black Sea dolphins
- Automation of experimental research on complex systems.

Photos and functional diagrams are included with much of the experimental data presented. [Bionika (Bionics), AN UkrSSR, Kiyev, Izdvo Naukova dumka, no. 9, 1975, 160 p.]

5 Kilojoule CO_2 Laser (abstract)

The latest large-volume atmospheric CO_2 laser developed by Prokhorov's team at FIAN is described and its structural details given. The laser uses a 270 liter active volume, placed within a 4500 liter plexiglass-lined steel CO_2 reservoir; active vessel dimensions are 30x30x300 cm. E-beam pumping is used, employing a multi-needle cathode with explosive field emission which develops 150 kiloampere, 2 microsecond pulses at 125 kv diode voltage. Structural details of the diode and resonator are included.

Tests so far show a stable pulsed output of 5 kj at 26% efficiency. Increased yield with larger sized optics is anticipated. Deterioration of the output mirror is mentioned but not detailed. The design is offered as the most powerful of its type to date. [Bychkov, Yu. I., Ye. K. Karlova et al. Pulsed CO_2 laser with 5 kj energy. ZhTF P, v. 2, no. 5, 1976, 212-216].

Laser-Driven Reaction Engine (abstract)

Past studies in high power lasers have investigated the possibility of propelling a spacecraft by reactive thrust from laser beam vaporization of an onboard target material. For practical purposes, however, this would require laser performance well above that presently available, i.e. c-w power of 10^9 watts or more, and beam divergence below 10^{-5} rad.

A team at FIAN suggests a more modest variant of this scheme in which an air-breathing craft could be propelled by a laser beam of reasonably attainable power. The method would use a pulsed defocused beam transmitted from earth or another aircraft, which would be focused by the receiving vehicle antenna to form a repeated optical discharge in the air behind the antenna. The shock waves resulting from each pulse discharge would impinge on the antenna, giving a cumulative thrust, assuming that a fresh air charge was introduced into the focal region with successive pulses.

The authors calculate that with modest focused intensities, on the order of 10^6 w/cm^2 at CO_2 laser wavelengths, at a pulse width of about one microsecond, a practical reactive engine is attainable that needs no other fuel than ambient air. Preliminary lab tests with a CO_2 laser have in fact shown that an average 50 kg of thrust force would be developed by an average laser power of 10 Mw, using 1-10 microsec. pulses at a 300 Hz repetition rate. A fuller description of the test results is promised in a later publication. [Barchukov, A. I., F. V. Bunkin, V. I. Konov, and A. M. Prokhorov. Laser air-reactive engine. ZhETF P, v. 23, no. 5, 1976, 237-240].

Recent Achievements in Chemistry, Metallurgy and Chemical Technology (abstract)

Soviet progress over the last few years is outlined in various branches of inorganic chemistry, analytical chemistry, chemistry of semi-conductors, science of materials (heat resistant, structural, metallic), metallurgical processes and theoretical chemical technology.

Development of refractory compounds of light elements (borides, nitrides, carbides, silicides, etc.) for atomic energy, new heat-resistant dielectrics and electrodes for MHD generators, laser-induced high-rate chemical reactions, synthesis of new actinides (including element 106) are cited as the most notable advances in inorganic chemistry. Industrial production of binary and ternary compound semiconductors, chalcogenide glasses, epitaxial structures of silicon, germanium, gallium arsenide, gallium phosphide and A^3B^5-based solid solutions are the result of recent advances in chemistry and technology of semiconductors.

Successful development is noted of new production processes for refractory rare metal oxides, high-refractory granular oxide ceramics, refractory high-strength and high corrosion-resistant oxygen-free materials (borides, carbides, etc.), fibrous asbestos and phosphate structural materials, inorganic fiber-reinforced phosphate laminates, and high-refractory concrete. Pyroceramic (sitall) corner reflectors, with better than 92% transmission, for lunar lidar have been developed on the basis of a new theory of glass crystallization. The most important new structural metallic materials are the strongest known Al alloy with 65 kg/mm^2 transverse yield strength, the type VNL3 cast stainless steel with 125 kg/mm^2 ultimate strength for complex shapes, and a series of titanium alloys used in sensitive structural parts of the Luna-16 and Luna-17 craft and the undercarriage of the Soviet moon rover. The scientific basis has been developed for production of high-strength, high-modulus ($\sim 20,000$ kg/mm^2) carbon fibers, and processing technology of boron fibers has been improved. Future trends are outlined in development of high-strength, low-density alloys for aviation and space technology and high-modulus (to $30,000$ kg/mm^2) fiber-reinforced composites. [Zhavoronkov, N. M. Soviet advances in chemistry, metallurgy and chemical technology. VAN no. 1, 1976, 75-92].

High Temperature Press (verbatim)

A patent disclosure is presented on a high temperature press. The design consists of ring-bound dies provided with circular lugs and recesses in opposed surfaces, the latter forming a high-pressure chamber, when die edges are linked. To increase service life, the circular lugs are made in the recesses at a distance from the edges equal to 0.2-0.5 of the recess depth. The lug with one of its planes parallel to die edges, the lug formed by varying slope of die walls in the recess, and the lug as a self-contained part, are variants suggested in the design. [Shul'zhenko, A. A., Yu. G. Rittel', A. V. Gerasimovich, V. D. Yakimenko, Yu. S. Maslenko and A. F. Get'man. A device for obtaining high-pressures and high temperatures. Otkr, izobr, no. 3, 1976, patent no. 499888].

High-Pressure Chamber (verbatim)

A patent disclosure is offered on a high pressure chamber. The chamber contains moving and static co-axial pistons and anvils, a power member, and a device for controlling slope of the anvil working surfaces. To increase accuracy of anvil adjustment, the chamber is equipped with support plates, with pistons and anvils positioned in the plates. A circular feather tongue on the static piston is provided for guiding the moving piston. The slope-controlling device is combined with the power member and is made in the form of self-centering screws interconnecting the support plates. Regulating flywheels are attached. [Aspandiyarov, S. B. and N. V. Korolev. A high-pressure chamber. Otkr, izobr, no. 3, 1976, patent no. 500076].

Ultra-High Pressure Apparatus (verbatim)

. A la   volume chamber is proposed for ultra-high pressures. The chamber consis   f two dies in which mated stepped cavities are provieded. A container made of pyrophyllite, catlinite or boron nitride is placed in the highest central part of the cavity. Metallic washers separated by an electroinsulating spacer (paper, fiber, asbestos or mica) are used to prevent outflow from the container. The washers, which close the inter-die gap, occupy only the peripheral part of the chamber. The remaining cavity volume is filled with a highly compressible material (KBr, teflon or vinyl polymer) which provides the required working conditions. [Marzurenko, A. M. Apparatus for creating ultra-high pressures. Authors' Certificate No. 436754, published Dec. 30, 1974 (RZhF, 1/76, no. 11455 P)].

Solids Under Megabar Pressure (abstract)

A reduced isothermal equation of state is introduced to describe compression $x = V/V_o$ of solids versus relative pressure P/K_o, where P is in the megabar range and K_o is the bulk modulus of elasticity. The equation may be applied to metals, compounds and metallic hydrogen, since it is based on the simplest expression of the potential of interatomic interaction, common to a variety of substances, and excludes the effect of initial compressibility.

A graphic presentation of experimental x data versus P/K_o shows that the contribution of individual properties of specimens to the reduced equation of state is small. Experimental x versus P/K_o plots show that the equations of Birch (J. Geophys. Res., v. 57, 1952, 227) and Keane (Austral. J. Phys., v. 7, 1954, 322) also can be used to evaluate x of untested substances. K_o is the only individual characteristic which must be determined by ultrasonic measurements [Voronov, F. F. Compression of solids at a high pressure. DAN SSSR, v. 226, no. 5, 1976, 1052-1054]. .

High-Modulus Aluminum Nitride Whiskers (verbatim).

A collection of articles on nitride research, published in Kiev in 1975, describes aluminum nitride whiskers which were obtained by nitriding Al metal or reducing aluminum oxide with carbon in a nitrogen-carbon [CO_2?] mixture. The whiskers were grown in a high-temperature apparatus with graphite heater. Growth by a reduction technique was found to be rapid, stable and uniform; whiskers thus produced were of higher quality and exhibited a lesser variation in their mechanical characteristics, hence these whiskers were used in the study of mechanical characteristics. Their maximum strength was found to be 770 kg/mm^2, average strain was 1 to 2% and the elastic modulus was 1,000 to 17,000 kg/mm^2 for hexagonal or rhombic cross-sections and 30,000 to 40,000 kg/mm^2 for square or rectangular cross sections. [Tavadze, F. N., G. M. Surmava and A. A. Nikolaishvili. Preparation of aluminum nitride whiskers and study of their mechanical characteristics. IN: Sb. Issledovaniye nitridov. Kiyev, 1975, 95-100. (RZhF 18E, 3/76, no. 3E536)].

Hybrid Magnet Develops 250,000 Oersted (abstract)

A. M. Prokhorov describes in a newspaper article the development of a large copper disk water-cooled solenoid which has generated 150 koe at ambient pressures of 15 kbar and temperatures to -270 C. In collaboration with the Kurchatov Institute, this solenoid has been combined with a superconducting solenoid to form the hybrid KS-250 system, credited with attaining a 250 koe field, claimed as the strongest known to date. Among the uses cited for this level of field are material studies, including semi-conductors; MHD; particle accelerators; plasma physics; thermonuclear studies, and magnetic spectrometry. [Prokhorov, A. M. Full power of the magnetic field. Krasnya zvezda, 11 March 1976, p. 4].

Ultrasound Improves Storage Battery (verbatim)

Ultrasonic treatment of an electrolyte or distilled water used to prepare it can cause an increase in discharge current, notably a low discharge current. Research data show that intensification of electrolyte diffusion into a nickel electrode and the reaction $Ni(OH)_2 + OH^- = NiOOH + H_2O + 1$ are the underlying causes of the ultrasonic effect. [Mihu, V. and I. Gavrila. Effect of ultrasound on a nickel-cadmium storage battery. An. Univ. Bucuresti Sti. natur., no. 23, 1974, 29-34. (RZhKh 19L, 2/76, no. 2L205)].

Storage Battery for Aircraft (verbatim)

A patent disclosure has been published on a new nickel-cadmium alkaline storage battery. The battery cells are enclosed in a metal container with a plastic lid, inside which stiffening ribs and rubber shock absorbers are fixed. Vertical ribs and bus bar which connect the cells in series are positioned along the inner walls of the plastic cells, on the side of adjacent electrodes. Electrolyte level holes are provided in two opposed walls of the container. A plug socket on the third wall is provided for battery connection to the load. The sockets are shaped as hollow, vertically split cylinders with external coiled helical springs.

To improve specific characteristics and increase operational reliability, each cell is provided with an insulating plate laid on top of the terminals plate. The ratio of the insulating plate surface to the internal section of a cell is 0.85 to 0.95. The ratio of the gap between two adjacent vertical ribs to the width of the adjacent outermost electrode is 0.15 to 0.25. The ratio of the width of a rib-electrode contact surface to the gap between two adjacent ribs is 0.1 to 0.25. [Tsygankov, M. S., V. N. Fateyeva, N. A. Bityutskaya, et al. Nickel-cadmium alkaline storage battery. Otkr, izobr, no. 1, 1976, patent no. 498670].

Nickel Boride Activated Carbon Electrode for Fuel Cell (abstract)

Experimental half-cell data are given on performance of nickel boride-activated carbon electrodes, in electrochemical oxidation of hydrazine fuel in a 6M KOH electrolyte. Electrodes made of various carbons, either untreated or pretreated in different media, were tested. An electrode of carbon obtained by pyrolysis of saccharose exhibited the highest catalytic activity. Typical polarization curves are shown for differently treated type KAD carbon electrodes. It is concluded that nickel boride-impregnated carbon electrodes can be used in electrochemical power sources with liquid hydrazine fuel, on the condition that the electrode be sintered in an inert gas atmosphere. [Sofronkov, A. N., Yu. A. Tkach and S. D. Korolenko. Study of a nickel boride-catalyzed carbon electrode for electrochemical power sources. ZhPKh, no. 1, 1976, 220-222].

Tunable Silicon Carbide Photosensor (abstract)

A p-n-n$^+$ diode with extended n-region is introduced as a photosensor with controllable spectral response. The p-n-n$^+$ structure is made of β-SiC single crystal with silumin contacts. The measured ratios of short-circuit currents through the diode illuminated at 490 and 415 nm correlate well with the dimensions of the n-region.

The shape of the volt-ampere characteristic vs. illumination mode evidently reflects a peculiarity of current flow and photoeffect in an extended structure with two potential barriers. The V-A characteristic shows that the ratio of the short-wave to long-wave regions of spectral response must vary with load resistance; specifically, the spectral response peak shifts toward shorter wavelengths when load resistance is increased. Hence the spectral response of a β-SiC photodiode can be controlled by varying its load resistance. [Kiselev, V. S. Silicon carbide photosensor with a tunable spectral response. ZhTF P, v. 2, no. 4, 1976, 185-187].

Radiation from a Hypersonic Magnetoplasma Jet (abstract)

Spectral composition of visible radiation from Ar and He plasma jets was determined, using photographic and photoelectric recordings of plasma emission spectra. The plasma was generated by a stationary magnetodynamic source with gas discharge in a rarefied medium. Population of the upper excitation levels of ions and atoms was calculated from spectral line intensities. The observed populations in the initial jet segment are explained in terms of a corona model of ionization and, further along the jet flow, by recombination with superequilibrium of upper levels. Introduction of fluorides (SF$_6$, teflon decomposition products) causes a drop in electron density and an increase in electron temperature. Consequently, population of certain levels (4p, 4p') increases selectively. This selective increase is explained in terms of the corona model. [Gol'dfarb, V. M., Ye. V. Il'ina, G. A. Luk'yanov, V. V. Nazarov, N. O. Pavlova and V. V. Sakhin. Radiation from argon and helium plasma hypersonic jets generated by a magnetodynamic source. TVT, no. 1, 1976, 10-16].

New Electron Gun (abstract)

A thermionic electron gun is reported which emits ~ 100 keV rectangular electron beams of 1 meter cross-section to the atmosphere through an Al foil window. The electro-optical system of the gun is made of a periodical structure of filamentary thermocathodes, placed in an electric field between the focusing electrode and the anode. The system was optimized by computerized analysis to assure a uniform anode electron current density. At a 10^{-4} A/cm^2 current density, nonuniformity of current distribution was found experimentally not to be over 20%. A sectional electron gun was developed on the basis of this system and has been tested under service conditions. At 120 kV accelerating potential, current density beyond an $18\,\mu$m thick Al window was found to be 10^{-4} A/cm^2. Up to 70% fraction of total current may be extracted from the gun, depending on the potential and foil thickness. [Fedorov, V. I. and L. P. Shanturin. Electron gun with a large cross-section beam output to the atmosphere. PTE, no. 1, 1976, 153-155].

E-Beam Tests in Air (abstract)

Tests are reported on the "Impul's" accelerator to determine optimum parameters of a pulsed electron beam discharge into air. The bulk of the experiment was done with 20 kiloampere pulses of 50 nsec duration, transmitted on the order of one meter in air at various pressures, and with an axial magnetic field around the discharge tube. Data are given on transmitted power as a function of ambient pressure and of path length.

Results show a nonmonotonic pressure characteristic, with transmission efficiency peaks at 0.3 and again at 3 torr for a one meter path length; approximately 70% peak efficiency was observed. Attenuation tests over a 150 cm path showed drops in the range of 0.4 to 0.8 joule/cm. The tests confirm that most effective beam transport occurs with compensation of the beam self-field. [Kolomenskiy, A. A., Ye. G. Krastelev et al. Transmission of a powerful relativistic electron beam in gas. KSpF, no. 6, 1975, 11-14].

Magnetic Suspension of Rotors (abstract)

Two variants of a dual tandem ferromagnetic rotor system have been developed at Perm State University, using magnetic suspension with feedback to hold the rotors in a stable attitude. Schematics and structural details of the rotor assemblies are given. The largest rotor, acting as a solenoid core, is 180 mm long. Continuous stable operation for periods on the order of one day are mentioned. While no specific use for the system is advanced, it is seen as potentially useful for determining braking torque from radiometer effects, earth rotation, and detection of gravitational waves. A photo of a suspension system is included. [Ponizovskiy, V. M. Dual magnetic suspension of ferromagnetic rotors. PTE, no. 1, 1976, 181-183].

Sea Ice Formation Studied by Airborne Radar (abstract)

A high-sensitivity airborne radiometer has been used to measure r-f thermal radiation from ice surfaces in the Northern Caspian Sea. Surface brightness data were recorded in December 1973 aboard an IL-18 flying laboratory.

The recordings show different ice forms, and make it possible to estimate new ice thickness, snow cover and to detect onset of ice formation, which is impossible to observe visually or by aerophotography. A detailed ice chart was plotted, using radiometric data obtained under weather conditions unfavorable to visual or aerial surveillance. The chart shows a highly dynamic growth of various ice forms and fast ice formation. Important variations in ice compactness were detected. [Bespalova, Ye. A., Yu. I. Rabinovich, Ye. A. Sharkov, T. A. Shiryayeva and V. S. Etkin. Study of ice formation using airborne measurements of r-f thermal radiation. Metrologiya i gidrologiya, no. 2, 1976, 68-72].

Seminar on Optical Data Processing (verbatim)

A brief review is given of the collected papers from the Fourth All-Union Seminar on Optical and Electrooptical Methods and Devices for Conversion, Processing, Storage and Transmission of Data. The collection is divided into three chapters dealing with optical data input and output, development of electro-optical devices for data processing and their structural elements, and optical methods and devices for data processing. Data are included on specific systems and elements which have been manufactured in the USSR. [Opticheskaya i elektroopticheskaya obrabotka informatsii (Optical and electro-optical data processing). Moskva, Izd-vo Nauka, 1975, 190 p. (RZhF, 11/75, no. 11D1509 K)].

Resolution of an Image Converter with Complex Raster (abstract)

The ultimate resolving capability of an electron-optical converter with a linear frequency modulated raster is analyzed theoretically, in comparison with that of a simple raster with a slit aperture. The analysis is based on the theory of complex signals. Spatial resolution of the converter is expressed as the output signal-to-noise ratio (SNR) with optimum filter. The SNR of simple and complex rasters are formulated, assuming that signal with noise mixing is additive and photomultiplier noise is white. The condition for resolution equivalence is formulated, excluding sweep rates of the two raster types.

The expression for SNR ratio of the two raster types shows that resolution is limited by white noise and background currents. It is further shown that for high white noise relative to photo multiplier current, the use of the complex raster becomes clearly advantageous, hence a thorough analysis of noise spectral components should be made in order to select the optimum raster type in a given application. [Makarevich, R. N. Resolution of electron-optical devices with a complex raster. IVUZ Priboro, no. 1, 1976, 118-122].

Remote Temperature Sensor Optimization (verbatim)

Selection criteria are discussed for a long-wave thermal radiation detector used at the Leningrad Electrctechnical Institute for measuring temperature of a surface, from the surface or from a helicopter. The selection was based on experimental data accumulated by the author and the Academy's Institute of Atmospheric Physics, from satellite, airborne and ground measurements. Operation of a simplified model of the detector and physical aspects of measuring surface temperature, using this detector, are examined briefly from the standpoint of radiation theory. To increase accuracy of measurements the author eliminated preliminary calibration of the detector, because of variability of the calibration factor. A more accurate calibration factor could be obtained by systematic introduction of a black body simulator with surface temperature control, each time the surface tempeature is measured. [Orlov, V. N. Selecting a sensor for remote measurement of a surface, from a surface point or from a helicopter. IN: Ukr. nauchno-issledovatel'sky gidrometeorologicheskiy institut. Trudy, no. 138, 1975, 46-55. (RZhGeofiz, 2/76, no. 2B44)].

Chemical Theory of Ball Lightning (abstract)

According to a theory developed earlier by B. Smirnov, ball lightning is generated and sustained on account of energy released by ozone decomposition in the conducting duct of an ordinary lightning stroke. Air in the duct dissociates completely at 30,000° K and intermixes rapidly with cold air at the duct boundary to form a relatively cold air mass which contains ozone and nitrogen oxides in amounts well above equilibrium values.

Thermodynamic calculations show the possibility of ozone and nitrogen dioxide formation in quantity sufficient to sustain the ball lightning, especially in moist air. At a few percent concentration of ozone in the air after an ordinary lightning discharge, temperature of ball lightning is estimated to be 400 to 500° K. At ozone concentration of the order of 1% and 20 cm diam. of ball lightning, energy of the order of 10^2 j is stored in the ball. [Smirnov, B. M. Origin of ball lightning. DAN SSSR, v. 226, no. 4, 1976, 806-808].

More Theory on Ball Lightning (verbatim)

The problem of life-time of ball lightning is discussed in the framework of an earlier introduced, which allows a fairly accurate evaluation of life-time. It is postulated that radiation accompanies propagation of ions from the ball lightning envelope along curvilinear orbitals within electric and magnetic fields of the ball nucleus. It is the ionic energy that is radiated. After all its energy is radiated, the ion falls back to the ball nucleus.

Lifetime of ball lightning is evaluated by comparing total kinetic energy of the ball lightning envelope with e-m radiation intensity. The mechanism of ball lightning generation during a streak lightning discharge is proposed. [Grigor'yev, A. I. O vremeni sushchestvovaniya sharovoy molnii i vozmozhnykh mekhanizmakh yeye vozniknoveniya (Lifetime and possible mechanism of generation of ball lightning. Tomsk, 1975. Deposit at VINITI, no. 3159-75, 3 November 1975, 9 p. (RZhGeofiz, 2/76, no. 2B188)].

Advances in Computer Technology (abstract)

A leading Soviet specialist in computers, V. M. Glushkov, addresses problems in development of computer technology. Increased productivity of computing systems is considered as one of the most important problems. Applications of Josephson effect and interaction of two optical (laser) pulses to development of integral circuits are cited as the possible methods of increasing response speed by up to seven orders of magnitude. Application of the Josephson effect, holography and orthoferrites to design of high-speed, high-capacity memory devices is actively explored in many laboratories the world over. In the more distant future highly-efficient miniature systems of data processing are envisioned, if ordered atomic structures can be made into memory devices. But new problems arise in integral circuit technology from conflicting requirements of miniaturization, noise stability and reliability.

The ultimate goal of computer science is said by Glushkov to be the creation of brain-like structures of superhuman intellect. Various approaches to the problem of creating high-productivity multiprocessing computing systems are reviewed; specialization of processors is cited as a very promising method of increasing productivity of the computers. The importance is stressed of the mathematical equipment (programing optimization) of computers. Organization of computerized communication networks is also cited as an important aspect of computer development. A future state network of computing centers in the USSR is being designed for solving problems of accounting, planning and directing the national economy; this is the only specific reference to a long term Soviet computer program. [Glushkov, V. M. Scientific problems in development of computer technology. VAN, no. 2, 1976, 28-44].

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